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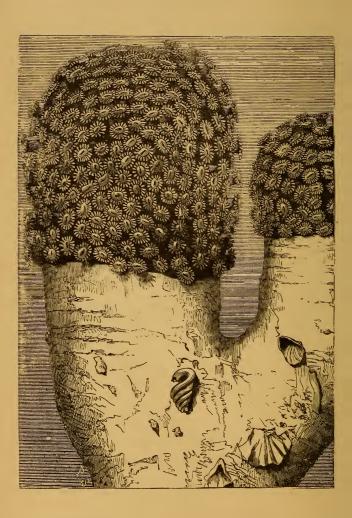














THE

BUILDERS OF THE SEA.

Rich Mayde

ILLUSTRATED.

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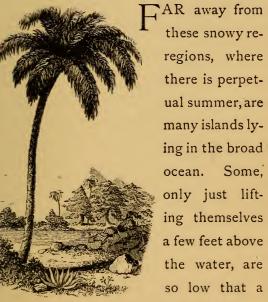


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THE BUILDERS OF THE SEA.



ship might pass near and hardly see them, except for the few cocoa nut trees that grow

upon them. But though the sailor may be weary of long days and nights of tossing on the unquiet sea, he does not hail this land with joy;—for these islands, beautiful as they seem, are full of danger. Many a good ship driven by the tempest has struck upon them as they lie almost invisible in the storm, and has been dashed to pieces, and many a brave sailor has awakened from dreams of home only to find himself sinking and drowning in the cruel waves.

How came these islands there! They are coral islands, and are the work of millions of little animals;—of animals so small that a little child might hold several in her hand. And now let us see what animals they are that do such wonderful things, and what we can learn about them.

Nearly all coral is made by polyps. You

have seen, of course, a garden aster in blos-



som. Well, the top, or disc, as it is called, of a polyp is very much like the blossom of

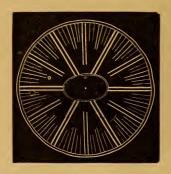
the aster, not only in shape and appearance, but in color, for polyps are of different colors; —some as bright as the rainbow, while others are almost colorless. Instead of the slight stem which supports the aster, however, the polyp has a stout body nearly as large as its disc, the bottom of which is firmly anchored to some rock. You will get a good idea of its shape from the picture on the page before this.

Polyps vary greatly in size. In some rare cases the disc is fourteen inches in diameter, while in others it has only the diameter of a small fraction of an inch. In the centre of the disc you notice an opening. This is the mouth of the animal, for we must not forget that it is animal though it looks so much like a flower. The many sharp-pointed projections around the mouth which compose the disc are called tentacles, and each one is armed

with many little lances or lassos tipped with poison. Woe to the unfortunate little crab who ventures too near. A hundred lassos are hurled at him—stupefied or killed by the poison, the tentacles seize him, and push him into the open mouth. This mouth is toothless, and opens directly into the stomach, and as the polyp is very elastic it is capable by stretching, of swallowing an animal as large as itself. When it has digested the meat of its unfortunate victim, it opens its mouth again, and pushes out the bones and other indigestible parts.

If one should cut suddenly, with a sharp knife, through the body of a polyp, it would look like the illustration on the next page. The dark oval in the centre of the picture is the stomach, which is connected with the outer part of the body by a series of

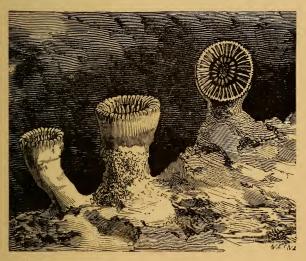
muscles, which pull it open to receive food, or contract it to expel the remains of its repast. When the polyp is attacked, by means of another set of muscles in its skin, it withdraws its tentacles, rolling its body up



over them, and so becomes merely a shapeless lump. After a time, when the danger is gone, opening its mouth it swallows a quantity of sea water, and so expands itself to its natural size.

Having examined the polyp, we will next

examine the coral which it forms. Here is a picture showing three of these coral formations, where the polyp itself has died and its body been washed away by the



waves. In the one which faces you can be seen a hollow in the centre. This was where the bottom of the stomach rested, for the coral is always formed at the very bottom of

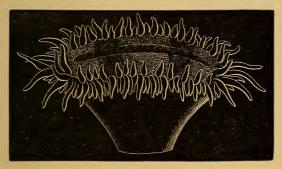
the polyp below its stomach. How the polyp forms this coral is not exactly known. But though it seems wonderful to us that a little animal should thus form stony matter from its food, it is not more strange than that man should form his bones, and that



they should increase in size. Coral is the bones of the polyp, and the little animal forms it by precisely the same process as that by which the bones in man are formed.

Here we have another picture of a coral after the polyp has died. You will notice that

although it is of a different species from the one last pictured, it is in most points similar. It comes from the Florida reefs, and in the picture is three times as large as it was in reality. The polyp who owned it is shown here.

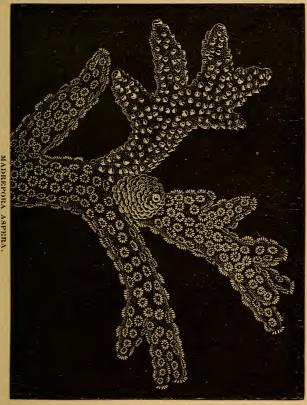


The way in which young polyps come into the world is this. A swelling begins on the side of a grown animal. It increases in size; presently a mouth opens; then come a set of tentacles, and the young polyp, now fully equipped, begins life on his own account.

As the young does not separate from its parent, and has many brothers and sisters about it, and as these in turn become parents, great masses of living animals are formed, which sometimes spread broadly, and again take branching forms like trees.

The foregoing is that of a species where a parent coral growing upward has given out young ones all around it as it grew. Then two or three of the young, perhaps more lusty than their fellows, have commenced to grow, and have themselves given out young, and so formed branches; and this process continually going on results in tree-like forms as we see them in the picture.

The coral formed by another species of polyp is represented in the next illustration. The mode of growth is here precisely the same as in the last, only as the polyp be-



MADREPORA ASPERA.



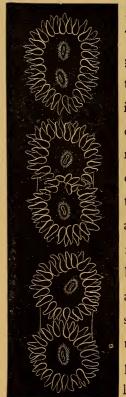


longs to a different species, it gives birth to young at longer intervals. Some species, instead of thus growing upward, broaden until mound is formed, in some cases twenty feet across. In such a mass as this there are millions of living polyps.

There is an-

other way in which polyps increase, which

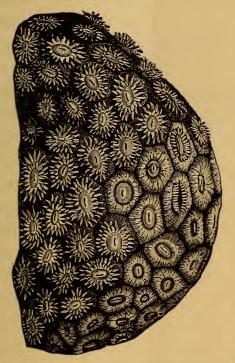
is called spontaneous fission, and which will



surprise you very much. The disc of the polyp begins to extend on one side, then another mouth opens in it, finally another set of tentacles surrounds the new mouth, and the new disc separates entirely from the old. While the discs are thus growing apart a new stomach is forming beneath the new mouth. and by the time that their separation is complete the new polyp is in every way prepared to earn his own living. This picture rep-

resenting the polyp during the various stages

of the process give a good idea of the way in which it comes about.



This mode of increase is the common kind in the large Astræa tribe, of which a speci-

men is shown here. This species forms vast mounds and hemispheres, sometimes ten or twenty feet broad, and the animal may often be seen in the different stages of division, now the new mouth just beginning to be



formed in the disc, and now the two disc.s just finally separated and distinct.

It is in these ways that the intricate forms—the branching trees, the leaf-like clusters, the delicate network, and the huge mounds of coral are formed. Strange and wonderfu as they may seem at first, they are all easily

accounted for if we only bear in mind the way in which polyps increase and grow.

The pictures so far have given a magni-



fied view of the discs of only two of different kinds of polyps. But there are very many species. On the preceding page is one called Caryophyllia, which grows in the Mediterranean, and is sometimes found still further north; and next we have a view of a species called Porites, in which you will notice that each of the little stars is a distinct animal.

This species is distinguished for making the lightest coral known, and in some cases it is even spongy.

In addition to the polyps already described, there is another great family which, though they do little toward adding to the material of the coral reef, are by far the most beautiful of all. They are flexible, and wave to and fro as the waters are disturbed. They are of the most beautiful colors imaginable -yellow, scarlet, purple, crimson, brownnearly every shade is seen. Some cannot stand upright, but hang like clusters of brilliant moss over the coral ledges, so that the gazer seems to see buds of brilliant flowers beneath the wave. In the large picture we have a sketch of one of this family. It





grew in the Fejees, and in life the tentacles were a pale brown which was shaded off at their extremities into a dark and much richer shade of the same color.

This family are called Alcyonoid, and they



can always be distinguished from other polyps in two ways. They have always exactly eight tentacles, and these tentacles are always fringed with delicate hair. This you will see from this picture. Some Alcyonoids are divided up largely into branches which are soft and flexible like the human hand, and being usually of a pale color, are known by the name of "dead men's fingers."

In addition to these points they are distinguished from coral-making polyps, by the very important fact that while the former cannot live at a depth of greater than one hundred and twenty feet, and in water below a temperature of sixty-eight degrees, these Alcyonoids are found in profusion at a depth of thousands of feet, and in the colder seas of the North.

In the next picture is given a specimen of this same family, in which the polyps form vertical tubes, which are bound together at intervals. This is called organ-pipe coral, from its resemblance to the pipes of an organ. The left-hand picture of the two is

an example of this; while the right-hand one is the polyp which makes the formation, much enlarged.

There is one more illustration, which we must give before finally dismissing the polyp, and that is of the red coral.



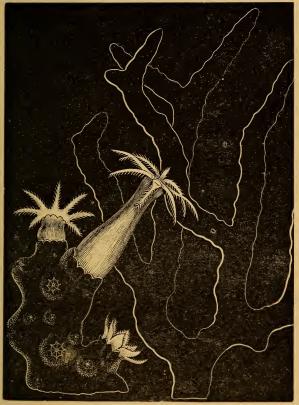
The large figure, which is given only in outline in the picture (see page 31), shows the branching forms in which this coral is made. These are covered thickly with polyps,

a magnified representation of several of which is seen in the lower left-hand corner.

The red coral grows chiefly in the Mediterranean, though it is found in other seas, and is obtained by diving and also by a rude net. This is formed of two heavy beams placed at right angles with one another, and covered with net-work, pieces of rope, and long strings of hemp.

To these beams heavy weights are attached, and the rude contrivance thus sunk is dragged after the vessel, breaking off fragments of the coral, which become entangled in the net-work, and so are brought to the surface.

The chief seat of the coral fishery is off the coast of Algiers and Tunis. Over four hundred small vessels are thus employed, leaving port in the early spring, and con-



RED CORAL.



tinuing their labors till the autumnal gales, which would prove too severe for their frail barks, force the fishermen to return. Every few weeks the coral is despatched to the manufactories at Leghorn, where, under the hands of skilful workmen it is made into various forms of jewelry. The deep red color is more highly esteemed in India, to which country large quantities are sent; while the pale rose color is the favorite among Europeans. Over four thousand men are engaged in the coral fisheries, and as much as forty tons are gathered yearly. Several curious beliefs are current among the fishermen, such as the idea that the coral is soft, but becomes hard through terror, when taken. They have also a legend that at the foot of Mount Alban, in a deep grotto, is growing a huge coral tree, large and strong

as an oak, which extends its arms when no danger is nigh, but withdraws them at the slightest approach of an enemy; and it is no unknown thing for credulous fishermen to waste their time in vain attempts to find and secure this rare prize.

CHAPTER II.

OW let us see what we have learned about polyps; that they are animals having a mouth and stomach; that they digest their food, and from it form coral by the same process as that by which the bones in man are made; that they are armed with poisontipped lassos as a means of defence, and that when attacked they withdraw as it were into themselves, offering no point of vantage. We have seen how they increase by budding, and by spontaneous fission, thus forming all the many varied forms of trees, leaf cluster and intricate net-work. We have seen that the discs vary greatly in size, and by means of the pictures we have had plainly brought before

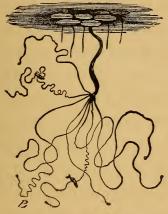
us some of the many varieties and species of polyps that exist.

It is evident that the many shapes in which coral is formed could not exist were the animal immovable. It follows then, that the polyp has the power of rising upward on the coral which it has made. In this way it often happens, that a polyp which is only a quarter of an inch in height, will be found on top of a coral branch several inches in length. As long as the polyp lives, there is absolutely no point at which it must stop. It may even grow till the surface of the water is reached, though then it will probably die of exposure.

Polyps are not the only coral makers. We have next a picture of a Hydra, an animal which is seldom more than half an inch in length, and is furnished with long slender tentacles. If any part of this animal is broken

off, a new part grows in place of what is lost, while the broken part grows into a new and complete animal.

Though it is very unimportant as a coral



maker in comparison with polyps, it still forms corals of beautiful shapes, as may be seen from the following picture of a species called Plumularia.

There are, beside those we have mentioned, two other organisms, that form coral, Bryazoans and Nullipores; but both are such small producers in comparison with those we have described, as to deserve only passing mention. The Bryazoan is an animal, while the Nullipore is a vegetable which grows vine-like over the coral formations, but is so largely formed of lime as to be brittle to the touch.

The species of coral makers that form reefs and islands will not grow in water that at any time of the year falls below the temperature of sixty-eight degrees; consequently the coral islands are all situated in or near the tropics, and the most vigorous species grow immediately near the equator, where the water reaches its greatest heat. It has been found by actual soundings too, that they cannot exist at a depth greater than one hundred and twenty feet. Nor can they exist





near the mouth of a river where sediment is apt to be formed. They require pure ocean water, and especially delight in channels and lagoons, and in the shallow waters near the breakers, where they grow to perfection.

We have no definite knowledge as to the rapidity with which polyps form coral, Doubtless some species secrete it much more rapidly than others; and doubtless too, many causes, such as the difference of temperature, the purity of the water, etc., combine to make the growth of the same species different in different cases. In the year 1793, the British frigate Severn was wrecked off Turk's Island. In 1857, descents were made to the wreck by divers in armor, and the middle part of the ship was found covered with what appeared to be a forest of coral, many of the branches being four inches in diameter and



sixteen feet in height. "To look among it from below reminds one of a thick growth of heavy timber," said the diver who explored the wreck. This coral was formed by Madrepores, a species of which a picture was given on page 17. We see that in this case sixteen feet were formed in sixty four years, a growth of three inches a year, but we do not know but the corals did not commence to grow till a long time after the ship was wrecked, nor do we know whether all species grow at the same rate.

And now let us examine a coral reef. In this picture we see on the right hand a reef close to the shore. This, as fringing the shore, is called a fringing reef. On the left we notice a reef lying out at a distance from the land. This is called a barrier reef, and between it and the shore is a quiet lagoon in which a ship might find a safe anchorage in the wildest storm, for while the billows are lashed to fury outside the barrier, inside all is calm.

All barrier reefs do not lie as close to the island as in this picture. Some are even ten miles from the shore, so that between them and the land lies quite an inland sea.

These barrier reefs are beds of coral that have grown until they reached the surface. Then the waves dashing over them, receding have carried off fragments of rock and sand, which the returning wave has washed back again. In process of time these accumulations have risen to a height of several feet above the sea level, and a beach is formed sloping down to the water edge. Outside of the reef, in the deep water, lie beds of coral, all growing slowly but surely upward. Over them all dash the tumbling billows, tearing and grinding—carrying off fragments to throw up on the beach to add to its height and firmness. With such force do the billows strike on these reefs that often after a storm the water presents a milky look for miles out at sea, owing to the fine grains of coral which it has worn away from the reefs during the storm.

Often the force of the waves tears channels through these barrier reefs, and through these the pure ocean water passes to and fro, bringing fresh nutriment to the growing coral within the lagoon. It is within the

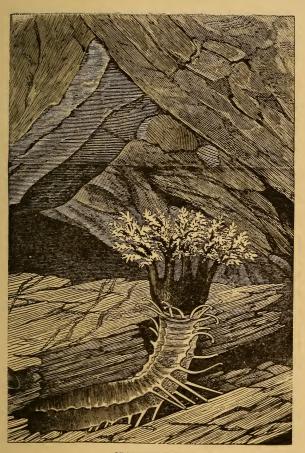


lagoon that the corals grow most vigorously. Here in the quiet waters nearly all species

flourish—some have already reached the surface, and the animals have died of exposure; others are but a few feet from the surface, while others again are far below the wave. In some places the lagoons have almost ceased to be lagoons, so many corals are above the water level. On the preceding page is a picture of such a lagoon. Sometimes a single branch of coral will rise to the surface, while all around it is deep water. On one occasion a United States war vessel, in entering a lagoon through a channel in the reef, struck violently against some obstacle with such force as to temporarily stop the ship. Soundings were at once made but nothing was discovered, all around being deep water, and it was then seen that the ship must have struck against some isolated column of coral with such force as to break it off, though it was strong enough to stop the vessel under full sail.

These coral reefs and lagoons are of great advantage to the islands which they surround. The earth washed down from the hills and brought down by rivers instead of being carried out to sea and lost, settle's in the lagoons and helps to fill them up, so that often large areas of new lands are added to islands. Then too, these lagoons are excellent training schools for seamanship, and so we find in the coral islands of the Pacific, a bold race of mariners who make voyages of hundreds of miles in the open sea, in rough boats of the most primitive construction. These lagoons, too, abound in fish, and at low tide the natives wade out with spears, and obtain rare sport and rich booty. It is from these lagoons that is obtained a species of food that is very popular in China. We mean the bechede-mer, or as the Chinese call it, trepang.

Of this, hundreds of tons are gathered from the coral reefs of the East Indian seas yearly, and find their way into soups and stews for the Oriental palate. Trepang are sometimes called sea slugs or cucumbers, from their shape. They vary in length from six inches to two feet or more, and live just beneath the sand, with the head projecting, on which grows a flower-like cluster. Dumont d'Urville gives an interesting account of the trepang fisheries. "During my excursion around Raffles Bay," he says, "I had remarked small heaps of stones surrounding a circular space. Their use remained a mystery until the Malayan fishers arrived. Scarce had their proas cast anchor when, without loss of time, they landed large iron kettles about three feet in diameter, and placed them on the stone heaps, the purpose of which at once became



SEA-CUCUMBER



clear to me. Close to this extemporized kitchen they then erected a shed, on four bamboo stakes, most likely for the purpose of drying the sea slugs in case of bad weather. Toward evening all preliminaries were finished, and the following morning we paid a visit to the fishermen, who gave us a friendly reception. Each proa had thirty-seven men on board, and carried six boats, which we found busily engaged in fishing. Seven or eight Malays, almost entirely naked, were diving near the ship to look for trepang at the bottom of the sea. The skipper alone stood upright and surveyed their labors with the keen eye of a master.

"A burning sun scorched the dripping heads of the divers, seemingly without incommoding them; no European would have been able to pursue the work for any length of time. It was about noon, and the skipper told us this was the best time for fishing, as the higher the sun, the more distinctly the diver is able to distinguish the trepang crawling at the bottom. About four in the afternoon the Malays had terminated their work, and before nightfall we saw their proas vanish from our sight."

The Feejee Islands are one of the best fishing grounds for trepang, and notwith-standing the well-known reputation of the islanders for ferocity and cannibalism, many American and European speculators are engaged in the fisheries there. Capt. Wilkes describes the operations of an American who was carrying on the fisheries there on a large scale. Before beginning, the services of some chief must be secured, who undertakes the building of the house, and sets his

dependents at work to fish. The usual price is a whale's tooth for a hogshead of the animals, just as they are taken on the reef; but they are also bought with muskets, powder, balls, vermilion, blue beads, and cotton cloth of the same color.

When the animals are brought on shore, they are measured into bins containing about fifty hogsheads, where they remain until next day. They are then cut along the belly for a length of three or four inches, and thrown into boilers, two men attending each pot, and relieving one another, so that the work may go on night and day. After draining they are next stretched on frame-work over slow fires for several days, when, being thoroughly dried, they are packed for transportation to Canton.

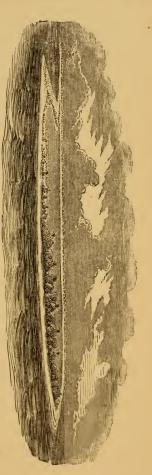
A thorough knowledge of the native char-

acter is essential to success, and vigilance must never be relaxed. No large canoes should ever be allowed to remain alongside the vessel, and a chief of high rank should be kept on board as a hostage, since these savages often attempt to cut off vessels. One of the most frequent methods is to dive and cut the cable, just before daybreak when the wind is blowing on shore. The moment the vessel strikes the reefs it is treated as a prize sent by the gods, and the crew murdered, roasted, and devoured.

We have shown how a coral reef is formed. First, over beds of coral growing upward, the waves have dashed, grinding off fragments of rock and sand, which they have piled up in among the growing corals until they have formed a reef which in time reaches above the sea level. The formation of a coral island

is precisely similar, except that instead of enclosing a mountainous island, the barrier reefs enclose a lagoon. This is the first stage in the history of a coral island, a barrier reef and within it a lagoon. As time goes on, and the accumulation on the reef increases, some seeds, wafted by the winds, fall into the sand and take root, and soon the encircling reef has in places a belt of verdure upon it as in this picture.

On the beach may



often be seen vast fragments of coral rock such as the foregoing, which was over eight feet square. Sometimes these blocks, by the



action of the water, have been worn into fantastic shapes, while in other cases they lie shapeless masses on the beach.



Outside of these coral reefs, the waters deepen rapidly. Often at a distance of a thousand feet seaward, the sounding line will de-

scend fifteen hundred feet without even then reaching bottom. From careful calculation it is estimated that in many of these reefs the coral formations are two thousand feet in depth. But we have seen that coral makers cannot exist at a greater depth than one hundred and twenty feet. How then was the bottom of these reefs formed?

If we turn back to the picture of an island on page 42, we shall see, close to the shore, what we have already described as a fringing reef. Let us now suppose that the island thus surrounded with a fringing reef, commences to sink, slowly settles down, and finally disappears beneath the waves. If this subsidence should go on only so fast as the coral grows upward, it is evident that gradually the fringing reef would change into a barrier reef; the barrier reef would be farther

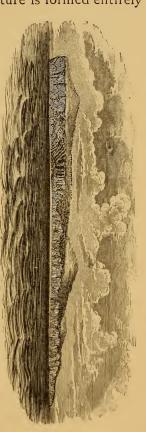
and farther from the shore, and finally the barrier reef would not encircle an island but a lagoon. This is precisely the way in which coral islands are formed, each one rests upon a sunken island, and each has originally been a fringing reef. So when, as is sometimes the case, we find a barrier reef ten miles distant from land, we know that formerly solid ground covered the ten miles of sea, and that it has all sunk beneath the waves.

These changes of level are by no means uncommon in the Pacific. The islands on which the coral reefs are built, are of volcanic origin, and while some have sunk down, and are still sinking, others are now stationary; while others again, after sinking slowly for ages, have by some new convulsion been elevated to nearly their old position.

We have here an example of this. The

island shown in this picture is formed entirely

of coral, and is two hundred and fifty feet in height above the sea level. For ages it had gone on slowly but surely settling down, for its height, two hundred and fifty feet, twice the depth that coral can live beneath the surface, shows that its formation had been a long and weary process. Let us stop and see how long it had been. Supposing that the original island is now as years ago just



level with the sea, and the two hundred and fifty feet of coral are all that has been formed. Now we do not know certainly, as we have already said, what is the yearly growth of coral, but in the most favorable case known, it was three inches a year. This mass of coral must have taken then for every foot of growth four years, or for the time of its complete formation one thousand years; so that for ten long centuries it had been gradually sinking till came the sudden convulsion that threw it up above the sea.

If this subsidence takes place at a faster rate than the growth of the coral, the animal dies and the reef building stops. Many such instances are known, and such reefs are called dead reefs. Their presence and character can of course be known only by sounding, as they are always at least one hundred and twenty-five feet below the sea level.

Coral, when analyzed, is found to consist almost entirely of the same components as ordinary limestone or marble, though it is generally a little harder and more brittle than they, as is shown by the ringing sound given out when it is struck by the hammer. In old times, it was supposed that it was comparatively soft in the water, and hardened on exposure to the air, an error which probably arose from mistaking coral still covered by the soft tissues of the animal for the rock itself.

Many speculations have been made, to account for the presence of the lime of which coral is formed, since in sea water but a small quantity of lime is held in solution. Some have supposed the existence of carbonic acid springs, though there is no proof of their existing in the region in which corals abound,

while others have brought forward equally improbable causes. Science and study have not as yet discovered the secret source from which the lime is derived. We know only that from the sea-water, and the food of the polyp, the coral rock is formed, and that it is by the same process as that by which the bones in man are formed.

CHAPTER III.

THE geographical position of coral reefs is determined by several circumstances. As we have already said, the temperature of the water must not fall below sixty-eight degrees in the coldest month of the year. Nor can coral grow where the shores are abrupt and deep, since they cannot exist at a greater depth than one hundred and twentyfive feet nor near the mouths of rivers, since the mud brought down by the current is fatal to their existence. The presence of volcanic heat, too, is fatal to them; and as many of the islands of the Pacific are of volcanic origin, and still agitated at times by throes when eruptions take place beneath the sea, it is no

uncommon thing to find beds of coral whence all life is gone, the animals having been killed by the excessive heat of the water.

This is shown in the case of Hawaii, one of the Hawaiian groups, which is still an active volcano. Around it are scarcely any signs of coral life, while other islands of the same group, where volcanic action has been long extinct, are surrounded with reefs.

From what we have said as to the temperature of sixty-eight degrees being the minimum under which coral reefs can be formed, it might be imagined that two straight lines drawn around the earth, one above and one below the equator, would include all coral reefs. But this is far from being the case. In the Atlantic Ocean, for instance, on the coast of Africa, the region of reefs is only eighteen degrees in width, while on the

American coast it is forty-eight degrees in width; and in the Pacific, while it is only twenty-five degrees wide on the American coast, it is forty-four on the Asiatic. This great difference is caused by oceanic currents, and these in turn are largely determined by the shape of the coasts. So when a current from the polar seas, with icy waters, comes southward, it narrows the limits of the coral makers, and when the warm Gulf Stream. bearing the heated waters of the tropics, goes northward, it extends their limits far beyond their natural boundary.

The Pacific Ocean is especially the site of coral islands. A glance at the map will show that to the north and east of Australia the ocean is everywhere dotted with them: some small in extent, while there is in one instance a single reef reaching four hundred

miles. Nearly all the islands of this region give evidence of volcanic action, bearing on their summits the sharp, ragged outlines of extinct craters, or as is often the case, being at the present time in constant and active operation. When we look over this vast region, thousands of miles in breadth, and see these many coral reefs, the monuments of buried lands, the imagination has no difficulty in believing that here once was a vast continent now sunk and lost beneath the sea.

In the Atlantic Ocean we find several large coral reefs. Off the Florida coast is an extensive one. The principal island of the group is Key West, a United States military station, and here the highest land is not twenty feet above high tide. A brackish water is procured by wells some fifteen feet in depth, sunk in the coral rock, and as the island is

very limited in extent, and almost destitute of vegetation, it can readily be imagined that to be assigned to duty there is not a matter for congratulation to any army officer.

A very valuable assistant in the labor of forming land is here found in a tree—the mangrove. It would be difficult to imagine a plant better adapted to island making than the mangrove. Its long, pendulous seeds fall into the shallow water, stick in the soft mud, and take root; the bud proceeding from the opposite extremity soon shoots up above the water, and sends down branches almost perpendicularly into the mud; these take root, and produce other trees, and so on. Besides these, lateral shoots are given off, and at a distance of three or four feet enter the water and take root; from the part above water others proceed, and take a similar

stride; and in this way they often travel twenty or thirty yards from the parent stem. Sea-weed and drift-wood become entangled among the stems, and very soon a permanent island is formed.

To the eastward of the Florida reefs, at a distance of about a hundred miles, lie the Bahama Islands. They are, with few exceptions, nearly unhabitable reefs, the terror of the mariner; for many a good ship is wrecked here every year. The principal island of the group, however, New Providence, supports a large negro population; while the town of Nassau, on its western side, carries on quite an active business and presents a decidedly gay appearance, especially when, after a wreck, its shops are decked with festoons of gaudy calicoes, the damaged spoils of the wreckers.

The island has almost no soil at all; the

stunted trees and the herbage which cover it grow out of the white coral rock which, worn and seamed by time and only partly hidden by verdure, suggests to the stranger a painful likeness to human bones and skulls. Where the gardens are made about the houses of the rich, a trench is first cut out of the rock with a hatchet, and then soil is procured from a distance.

But however dismal a picture this may present of the island as a place for a permanent home, the winter visitor is apt to consider it almost an Eden. For here he is certain that every morning his opening eyes will rest on the sunlight flickering through the leaves, and pleasant drives in the cool of the afternoon or sailing in the fresh breezes of the morning, take the place of the chilling east winds and the snows of the winter he has left behind him.

A short distance out beyond the wharves of the town lies a long and narrow reef, forming the outer barrier of the harbor, and against it, after a storm or high wind, the ocean waves dash furiously—rising high in air, to fall back as foam on the rocks below.

As so much has been said of the agency of ocean waves in forming coral reefs and islands, and so much stress has been laid on their enormous power, it seems not out of place to give some instance of what that power really is. The Bell Rock Light-house is off the coast of Scotland, and rises to a height of one hundred and twelve feet above the tide. It is no uncommon thing for the entire structure, to its highest stone, to be completely buried in spray, so that the light temporarily disappears.

In 1807, during the erection of this light-

house, six large blocks of granite, which had been landed on the reef, were removed by the sea and thrown over a rising ledge to the distance of forty or fifty feet, and an anchor weighing twenty-two hundredweight was cast upon the surface of the rock.

The great storm of 1824, which carried away part of the breakwater at Plymouth, lifted huge masses of rock, from two to five tons in weight, from the bottom of the weather side, and rolled them fairly to the top of the pile. One block of limestone weighing seven tons was washed round the western extremity of the breakwater and swept to a distance of one hundred and fifty feet.

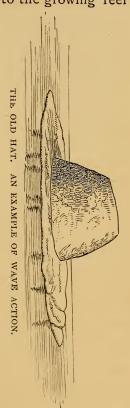
Along the English coast especially are seen examples of the destructive work of the ocean waves. Sir Charles Lyell, in 1829, made investigations at Sherringham, and

found that the water was twenty feet in depth in a certain part of the harbor of that town, where, forty-eight years before, a cliff was standing bearing on its summit several houses, all of which had been destroyed by the terrible hammer of the sea. Near the coast of Kent stood, in the time of the Roman occupation of Britain, Reculver, a then important military station. In the time of Henry the Eighth it was still a mile from the sea; but now it has entirely disappeared. The Roman walls, built to stand for ages, did sturdy battle with the waves for several years, until they were undermined and fell; and soon the old church, with its two tall spires, was abandoned to the sea.

When we read of such Titan-like labors it is no longer difficult to see how the huge blocks of coral are forced loose and tossed upon the beach, to add to the growing reef;

nor do we wonder at any of the strange forms which are the result of the wave action on the soft coral rock.

In addition to the reefs we have mentioned, others exist to the northward of the Bahamas, where the Bermuda Islands form the northern limit of reef growth, and to the south, where they are found among the West Indies and off



the coast of Brazil. The East India seas, too

are not without their reefs, but those which we have particularly mentioned are the most important of all.

Many of the coral reefs and islands of the Pacific are inhabited; some very densely. For instance, one called Taputeuea has only six square miles of habitable ground, and has a population of seven thousand people. Other islands, being nearly bare reefs, do not afford any resting place for human beings. The people that inhabit them are savages; some are cannibals, and all are intensely ignorant and idolatrous.

As may be readily imagined from what has been said of the coral islands and of the mode of their formation, but little vegetable life is found upon them. In all, only about thirty different species of plants flourish; and yet the natives make these of use in ways such

as we, who live in more favored lands, should never dream possible. Take, for example, the cocoa-nut tree, which is almost always found where any vegetable life at all exists. From its trunk are made the beams of houses, and the weapons of the people; the long foliage, when dried, forms excellent material for thatching the roofs; while the finer leaves, split and well oiled, are made into aprons and petticoats for the women. Mats, too, are, woven from them, either as a covering or to spread upon the ground. From the hard rind of the fruit are cut cups and dishes for water or food, while the fruit itself, in the various stages of growth, affords a cooling drink, and, later on, a rich milk. A plentiful oil, too, is obtained from the nut, with which the natives are accustomed to anoint their bodies, and those of strangers whom they wish to treat with especial attention. The husk of the nut yields a tough mass of fibres excellently adapted to tie together the beams of houses where nails are not to be had; while, finally, from the bud itself, before the fruit is formed, is obtained a large quantity of a sweet liquor from which a species of molasses is made, or, if fermentation is allowed, a species of rum.

Birds abound about many of the coral reefs, and are often of the most beautiful colors. From the fact that many of the islands are uninhabited, and seldom visited by strangers, they are almost ignorant of fear. Professor Dana speaks of one of the islands of the Paumotus group, where no native had ever been, and where the birds were so tame that they took them from the trees as they would fruit.

Another visitor to these islands of the Pacific, writing of the birds at considerable length, says:

"From fifteen to twenty varieties of birds may be distinguished among those frequenting the islands; of which the principal are gannets and boobies, frigate-birds, tropic birds, tern, noddies, petrels, and some game birds, as the curlew, snipe, and plover. Of tern there are several species. These frequent the island twice in the year, for the purpose of breeding. They rest on the ground, making no nests, but selecting tufts of grass, where such may be found, under which to lay their eggs. I have seen acres of ground thus thickly covered by these birds, whose numbers might be told by millions. Between the breeding seasons they diminish considerably in numbers, though they never entirely desert the island. They are expert fishers, and venture far out to sea in quest of prey. The noddies are also very numerous. They are black birds, somewhat larger than pigeons, with much longer wings, and are very simple and stupid. They burrow holes in the guano, in which they live and raise their young, generally inhabiting that part of the deposit which is shallowest and driest. Their numbers seem to be about the same throughout the year. The gannet and booby, two closely allied species, are represented by two or three varieties. They are large birds, and great devourers of fish, which they take very expertly, not only catching those that leap out of the water, but diving beneath the surface for them. They are very awkward and unwieldy on land, and may be easily overtaken and captured, if indeed they





attempt to escape at all on the approach of man. They rest on trees wherever there is

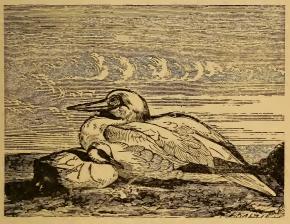


STORMY PETRELS.

opportunity, but in these islands they collect in great groups on the ground, where they lay their eggs and raise their young. One variety, not very numerous, has the habit of building up a pile of twigs and sticks, twenty or thirty inches in height, particularly where material of that sort is at hand, on which they make their nests. When frightened, these birds disgorge the contents of their stomachs, the capacity of which is sometimes very astonishing. They are gross feeders, and I have often seen one disgorge three or four large flying-fish, fifteen or eighteen inches in length.

"The frigate-bird is large and rapacious, the tyrant of the feathered community. It lives almost entirely by piracy, forcing other birds to contribute to its support. These frigate-birds hover over the island constantly, lying in wait for fishing birds returning from the sea, to whom they give chase,

and the pursued bird escapes only by disgorging its prey, which the pursuer very adroitly catches in the air. They also prey upon flying-fish and others that leap from sea to sea, but never dive for fish.

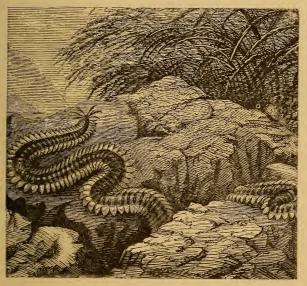


THE GANNEIS.

"Besides these, are the tropic birds, which are found in considerable numbers on islands where there are large blocks or fragments of beach rock scattered over the surface, under which they burrow out nests for themselves.

"Some of the social habits of these birds are worthy of remark. The gannets and boobies usually crowd together in a very exclusive manner. The frigate-birds likewise keep themselves distinct from other kinds. The tern appropriate to themselves a certain portion of the island; each family collects in its accustomed roosting-place, but all in peace and harmony. The feud between the fishing birds and their oppressors, the frigate-birds, is only active in the air; if the gannet or booby can but reach the land and plant its feet on the ground, the pursuer gives up the chase immediately."

If we could plunge beneath the waves that dash upon the coral isles, we should see many strange and beautiful forms of animal life. Here are the sponges, covering the bottom of the sea with a carpet of many



THE BANDWORM,

colors, while in and out among them glide hundreds of species of marine worms, (Annellides) of rare beauty. Possessing every tint of the rainbow, they partly swim, and partly crawl over the sands, hiding themselves beneath them on the approach of an enemy. Some are so small as to be only an inch in length, while one, the great Bandworm, is from thirty to forty feet long. It is about half an inch broad, flat like a ribbon, of brown or violet color, and smooth and shining like lacquered leather. Among the loose stones, or in the hollows of the rocks, where he principally lives on minute shells that attach themselves to submarine bodies, this giant worm forms a thousand seemingly inextricable knots, which he is continually unravelling and tying. When, after having devoured all the food within his reach, or from some other cause, he desires to shift his quarters, he stretches out a long, dark-colored ribbon, with a head like that of a snake, but without its

wide mouth or dangerous fangs. The eye of the observer sees no contraction of the muscles, no apparent cause or instrument of locomotion; but the microscope teaches us that he glides along by the help of minute vibratory cilia, with which his whole body is covered. He hesitates, he tries here and there, until at last, and often at a distance of fifteen or twenty feet, he finds a stone to his taste; whereupon he slowly unrolls his length, to convey himself to his new restingplace, and while the entangled folds are unravelling themselves at one end, they form a new Gordian knot at the other.

Some of these marine worms form for themselves houses out of particles of sand, and shells of a long and tubular shape, in which they live, and from which they protrude the head only. Such are the scarlet Serpulæ. Upon their head they bear long and brilliantly colored tentacles, looking very



SCARLET SERPULÆ.

like a bunch of flowers, with which they seize and hold their prey.

Here, too, is to be seen the sea-urchin, looking like a gigantic chestnut burr, an oval



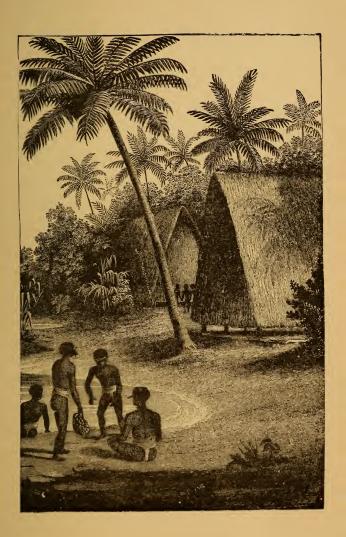
SEA URCHIN AND ROSY FEATHER STAR.

ball covered with long sharp spines, each one of which sets firmly into a socket on the hard shell, inside of which the animal lives. This

shell is indeed a beautiful example of the wisdom of the great Creator, for it is formed of hundreds of small sections welded together, so that the house grows by continual enlargement as its owner grows. The exactness of every portion of this house is seen after putting the shell into fresh water, where after a time it falls apart, showing each of the sections which helped to form it.

The Rosy-feather-star, too, in all its brilliant colors, is found beneath the coral wave. With its long and branching flower-like extremities, who would ever imagine that it was near akin to its more substantial neighbor the Echinus?

Hundreds of other beautiful and strange forms of animal life lie scattered through these ocean depths, to give the names only of which would take more space than we





have to spare. It is only when we leave the lower orders of animal life and pass to man, the highest, that we fail to find the same rare development; for the Coral Islander, under the most favorable circumstances, is merely a savage—ignorant, superstitious, and often cannibal. Where missionaries have labored and taught, their condition has greatly changed for the better, as in the case of the Sandwich Islands, where a whole nation has been converted; but their condition, where they have not come in contact with white men, is one of vast ignorance.

In 1840, the United States Government sent out an expedition to explore the coral islands of the Pacific. In the course of their voyages they discovered an island which had never before been visited by white men. The natives came off to the ship in canoes, but

could not by any means be persuaded to go on board. They took the ship's company to be gods who had visited them from the sun, and feared to come on board lest the ship should fly away into the sky, and bear them with her. On a cannon being fired, they fled in great haste to the shore. Boats were lowered from the ship, and a party visited the island. The savages received them with great deference, prostrating themselves, rubbing noses, embracing, and showing other marks of affection and reverence.

The visitors inspected their dwellings, which, rudely made and thatched, were scattered about under the cocoa-nut trees.

Their houses were bare of almost all articles of furniture, and indeed of the commonest household implements, and would form but scanty shelter against the storms of our





northern winter. Here, however, there is no winter: perpetual summer reigns. During certain seasons more rain falls than at other times; the vegetation is more luxuriant; but at no time are the trees without verdure, and cold and frost are unknown.

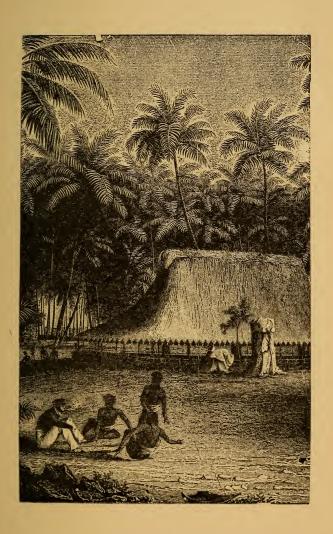
No traces of fire could be found in any of the houses, nor were there any arrangements for cooking; and from this it was supposed that the people must eat their food raw. Another thing that led to the same belief was the great wonder and alarm they showed at seeing smoke issue from the mouths of some of the party who had cigars.

The principal building was called in their language "tui tokelau," or the house of their god. It was built on the same general plan as their own houses, but was much larger in size, and furnished much more elaborately.

Outside were two idols, as shown in the picture. One was about fourteen feet high, and was closely wrapped in matting, while beside it was another smaller one, wrapped in the same way.

Notwithstanding their reverence for their guests, as visitors from the sun, the natives did not hesitate to steal from them in the most open way; and one gentleman, who had given a case of instruments to one to hold. was amazed to see him set off with it on a full run, and had a long chase before he could recover it. They were very anxious to procure fish-hooks and knives, the use of which they saw at once, and offered for them woven matting and boxes which they had cut out of wood, using sharks' teeth for knives.

On the lagoon side of the island they had built out over the water, houses supported





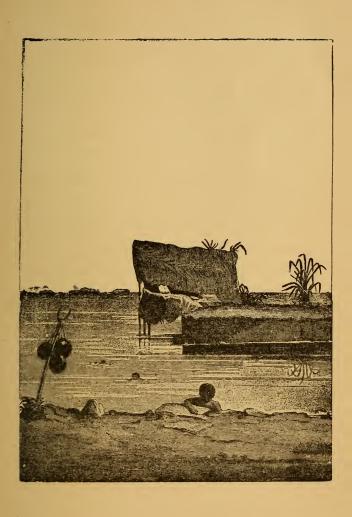
on poles, and thatched over to shelter their canoes.

These canoes are objects of especial care, from the difficulty with which they are obtained. The wood of the cocoa-nut tree being far too soft to make boats of, the canoes are formed entirely of logs brought to the beach by ocean currents; and to the ignorant people who know of no other lands beside their own, they seem direct gifts from their gods.

What must be the lives led by these people, knowing nothing of the world without them; of the broad continents, the mountains and rivers; seeing only their narrow strip of land and the broad expanse of never-changing sea: their knowledge of manufactures the weaving of mats, their only tools those made of sharks' teeth and stone. In many cases the effect of such a life is shown in their lan-

guage. They have no such words as mountain, river, hill, plain, and their limited vocabulary tells only of the poverty of their lives. Their situation, too, appears to act directly on their moral nature. From the missionaries who have labored to teach them of a better worship than that of idols, and whose efforts have met with wonderful success, we learn of many strange customs which were in vogue before christianity took root. Among the Fejee Islanders, for instance, when a child was born, it was the custom for a relative to name it at once. If for any cause this was omitted the child was thought to be an outcast, and its mother destroyed it.

It was a common habit for a son to notify a parent that it had become a burden and must die, or for an old person to decide that he was tired of living. On such occa-





sions the friends assembled as if to a funeral. with weeping and wailing. The person who was to die walked at the appointed time to the grave. Here each member of the company bade him farewell. He then chose whether he would be strangled or buried alive. If the former, a cord was twisted around his neck, and his life was soon ended; if the latter, he was assisted into the grave by his friends, his head was wrapped in matting and the earth was quickly piled upon him. On one occasion a native came to a missionary, and asked him to pray for his mother whose funeral was about to take place. Supposing that the woman was dead, the missionary offered to perform a service over her grave and joined the procession. Not seeing her body being carried, he asked as to the cause of its absence, and was astonished

to have pointed out to him an old woman with a cheerful countenance who was walking with the others. While he was demanding explanation the grave was reached, the party halted, and before he fairly knew what was about to happen, the cord had been applied to the woman's neck and she was a corpse.

Even deformed people and invalids are made away with in the same summary way. The missionary just spoken of knew of a case where a boy whose leg had been bitten off by a shark, though he had been nursed carefully by some white people, was strangled by his friends for no other reason than that he was thus deformed; while he with difficulty rescued a servant who for the crime of being ill was about to meet the same treatment from his friends.

These Fejee Islanders were cannibals as

lately as thirty or forty years ago, and so fond of human beings as food that they not only ate those who fell in battle against them, but their chief made no hesitation whenever he felt so disposed of killing a subject for a feast.

The religious beliefs of these people, before the missionaries labored among them, was strange indeed. The Fejee Islanders worshipped many gods. Chief of these was Ndengei, who had the form of a serpent, and before whom the spirits of the dead were summoned to appear. Not all were able to present themselves, however, for in the path to his dominions stood a huge giant armed with a club, who attacked every one that approached. If by ill fortune the dead man was struck, he could go no farther but must return and wander in misery about the earth;

if however he eluded the giant he passed on to a life of bliss. A virtuous life did not help any one to pass this dread opponent. The good and bad alike were attacked and luck alone decided. One valorous chief was believed to have gained heaven by his ingenuity. As he approached and saw his danger, he took up his weapon which was buried with him and hurled it at the giant, who was so much engaged in dodging the missile that the chief rushed by him in safety. The two sons of Ndengei, formed the second order of gods. They were stationed at the door of their father's abode, and transmitted to him the prayers of the dead spirits. A third order was formed by his grandchildren, while a fourth was composed of his more distant connections.

Besides these gods, they worshipped evil

spirits, who lived in Mbulu, or hell. Lothia was the chief, while near him was Samuialo, who sitting upon the brink of a great chasm, seized the incoming spirits, and hurled them into a fiery gulf below. The way to these dreary regions was through the sea and they lay far beneath the world.

These gods were served by priests called ambati, and small temples or mbures were built, one or more in every town, in which their rites were celebrated. Their influence over the common people was very great, for they claimed to repeat a message which had come direct from the gods. The ceremony of delivering such a message was somewhat like this. An offering was brought to the priest, a hog, or yams, or an elephant's tooth, and an answer was asked as for instance, whether the war with a neighboring island

would be successful. The priest stood quietly in sight of all, looking upon the ground; soon a spasm would seize him,-indicating that the god was entering his body,-his eyes would become bloodshot, and his body would writhe in violent convulsions. Then he would shout forth a message which to the credulous beholders seemed absolutely sacred. Gradually the spasm would die away, and soon the man would strike the ground with a club to denote that the god had departed and that he was again a man.

Every chief had his priest, and it is to be feared that he, and not the gods, dictated the message which the ignorant thought so sacred. Dependent on gifts, the priests were at times reduced to want. This however was never severe, for they could easily terrify their followers into supplying their wants.

A favorite way was to threaten to eat them, an announcement which never failed to bring them food.

These barbarous rites and false religions nave died away To-day, there is hardly an island in the Pacific where the Christian religion is not now the belief of nearly all the people, and where the worship of idols is not a thing of the past.



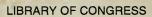














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